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Note on some Photographic Images of Mars taken in 1907 *by Professor Lowell.* By E. M. Antoniadi. (Plate 4.)

Some time ago Professor Percival Lowell, Director of the Flagstaff Observatory in Arizona (U.S.A.), had kindly sent to Mr. A. C. D. Crommelin a print showing 40 splendid images of Mars, taken by him on 1907 July 11, with various exposures, the mean longitude of the centre of the disk being nearly 250° at the time.

This print was handed on to me by Mr. Crommelin.

The amount of detail shown on these photographs is very considerable, and I have deemed it worth the while to submit these images to a thorough examination, and to group the various features shown on a large scale drawing. I have also decided to show no marking, traces of which could not be found on more than one image.

The fair publication of such a drawing is by no means an easy matter,—first, owing to the diffuse limits of the dusky spots, and to the very delicate gradations of the shading rendering interpretation exceedingly difficult; and secondly, owing to obstacles attending reproduction. The latter, however, can be avoided to a large extent by distrusting continuous grey shading, whose reproduction necessitates retouching on the part of the photographic engraver, and by boldly decomposing the duskiness into very small black dots and lines on a white ground. Upon a careful comparison with the originals, fig. 1, Plate 4, will be found satisfactory, as following closely the general appearance of the disk, except in the diffuseness of the limb and in the protrusion of white spots in its vicinity.

My observations of these photographs may be given as follows:—

(*a*) *Varying sharpness and appearance of the markings.*—Owing to atmospheric tremors, the 40 images differ widely in the amount of detail recorded. In addition to this, the self-same marking presents itself under varying forms. The two lakes at each end of the canal called *Cerberus*, for instance, are quite large, dark, and distinct on some images, while on others they are quite indistinguishable from the *Cerberus* mass. What at times appeared as a perfect dumb-bell was a few moments later distorted into a streak. This is a very instructive and *à priori* incredible fact, and one, too, which accounts for the greatly differing representations of the same object by different observers, or for the variety of sensations experienced by single observers on a given night.

(*b*) *The albedo of the limb.*—Another most interesting fact revealed by the photographs is that the superior brightness of the limb, which is so striking a feature in visual observations, especially under low powers, is entirely non-existent. The phenomenon is thus proved to be due to fatigue of the eye and to contrast,* so that the atmospheric layer above the visible markings of the

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* *Memoirs B.A.A.*, vol. x., part iii., p. 138.

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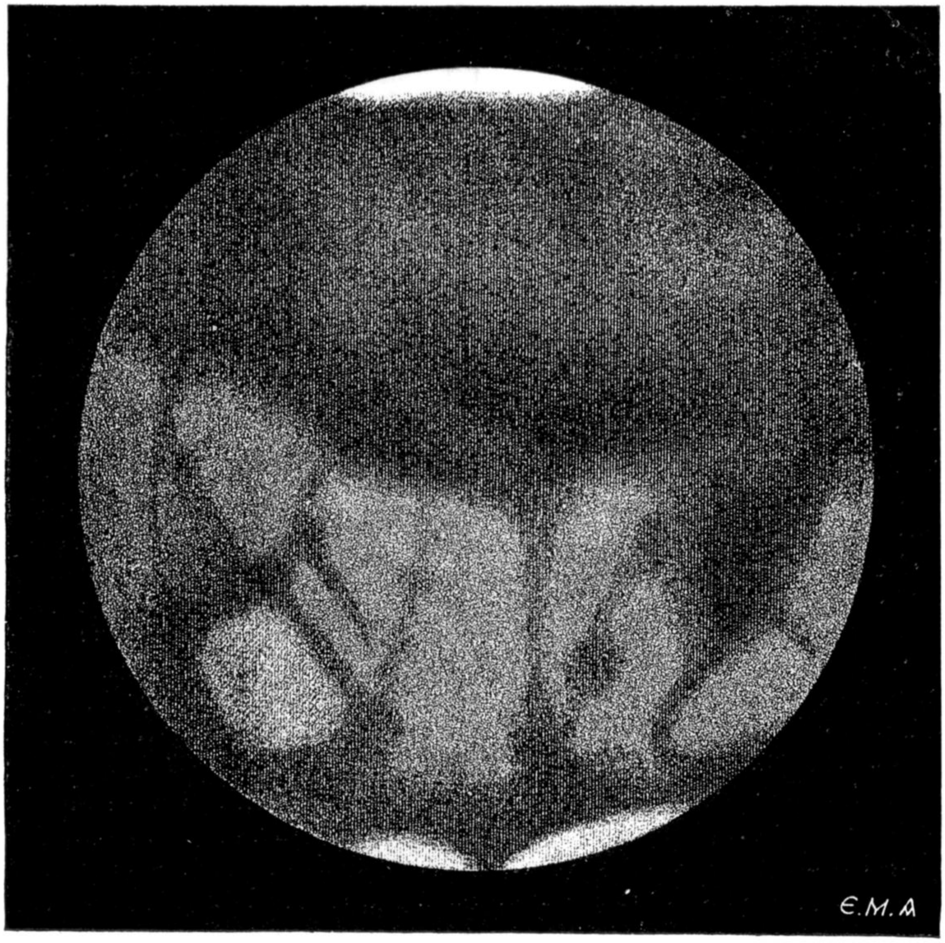

FIG. 1.—Drawing of Mars, showing all trustworthy details visible on photographs of the planet taken by Prof. Lowell on 1907 July 11. ω=250°.

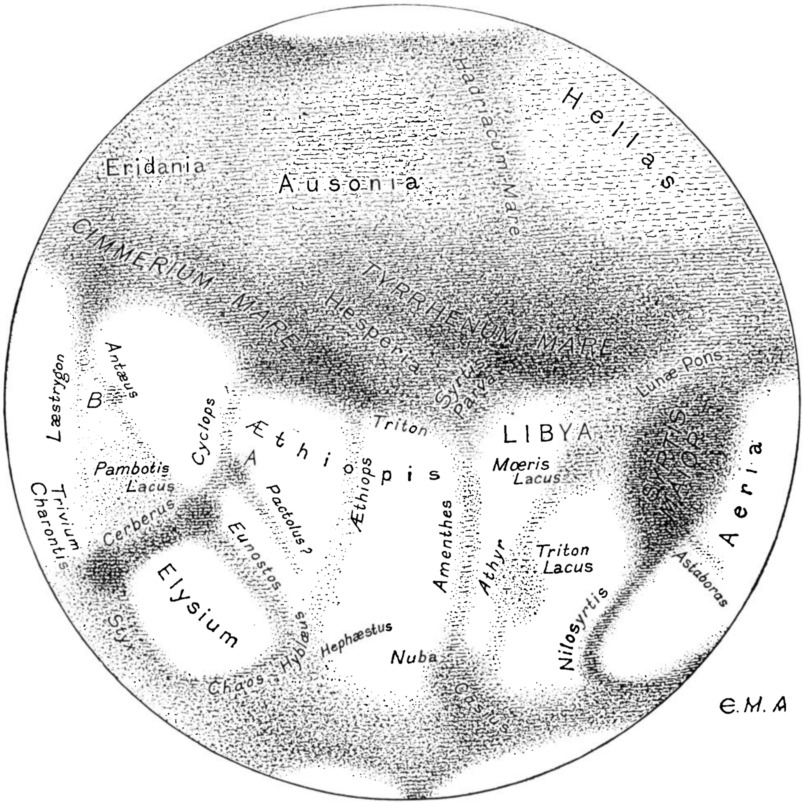

FIG. 2.—Key-chart.

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planet is virtually destitute of particles capable of reflecting sunlight. Hence, to an observer on Mars, as on the Moon, the stars would be readily visible on a dark sky in broad daylight.*

(*c*) *The lands whitening with the obliquity.*—It is impossible to speak authoritatively on this subject, as I have examined only the above 40 photographs, but from what is shown on them, my suspicion regarding the at least partial subjectivity of this phenomenon † seems confirmed, inasmuch as all three markings of this class visible near the limb on the photographs, namely *Hellas*, *Eridania* and *Aeria*, show no trace of increased brightness, while *Eridania* is even abnormally dark in the vicinity of the left limb.

(*d*) *The edges of the dark areas.*—As is well known, Professor Schiaparelli has depicted the *Maria* as bordered by darker canals towards the so-called continental regions whenever the markings were seen to double,‡ but no trace whatever of such a structure is discernible on the photographs.

(*e*) *The snow cap.*—The N. edge of the S. polar cap is almost straight, and not so convex to the centre of the disk as shown by visual observations. There is, moreover, a slight protuberant extension of the snow towards longitude 210°, and a very shallow recess towards longitude 245°. The dusky band round the cap is faint, except to the left, over *Thyle Insulæ.*

(*f*) *The large dusky areas.*—In accordance with Schiaparelli's map, that part of the S. hemisphere included between the N. edges of the *Maria* and the polar cap is dusky, or at least less photogenic photographically than the so-called continental regions, and we know that the islands in these expanses are of a ruddy tinge.

There is a broad dusky streak emerging from the snow cap towards longitude 275°, and trending in a slight curve into *Syrtis Minor*, although losing itself in the darkness of *Mare Tyrrhenum.* This seems to be *Hadriacum Mare* (see the key-chart, fig. 2). *Hellas* is large, and its appearance usual; *Ausonia* confused as a large mass extending as far as the polar land; *Mare Chronium* indistinct; *Eridania* dark. *Mare Tyrrhenum* is very dark above *Libya*, the darkness extending further S. than on Schiaparelli's charts.§ *Hesperia* is also very shaded, and seems to emerge rather from the faintish *Syrtis Parva* than from *Æthiopis*, which is contrary to what has been generally observed.

Mare Cimmerium is sharply pointed on *f.* side,‖ and shows two estuaries, that of *Cyclops* and that of *Læstrygon*, the latter very deeply indenting the yellow expanse to N. The darkest part of *Mare Cimmerium* was that between the *Cyclops* and the *f.* end.

Syrtis Major appears under the form given to it by Professor Lowell in 1894, and since observed at all apparitions of the planet.

* *Ibid.*, vol. ix., part iii., p. 74. † *Ibid.*, vol. ix., part iii., p. 104.

‡ *Knowledge*, 1903, pp. 247–248. § *Memorie*, i. to iv., plates.

‖ Major Molesworth has observed this in 1898–1899; also Cerulli during the same apparition (*Nuove Osservazioni di Marte*, Collurania, 1900).

Lunæ Pons is broad and diffuse. *Libya* also showed in 1907 Lowell's flattened form of 1894, rather than Schiaparelli's arched outline to S. and its S.W.* end was dusky.

(*g*) *Lakes.*—Seven of these objects are shown on the print: *Mœris Lacus* as a diffuse shading, situated on one-third of the way from the coast of *Syrtis Major* to *Amenthes*; † *Triton Lacus*, faint, broad and diffuse; *Pambotis Lacus* ‡ and *Trivium Charontis*, as two very conspicuous dark spots; *Nuba*, a diffuse shading on S.E. end of *Casius*; lastly the lake marked A on fig. 2, between *Pambotis Lacus* and *Mare Cimmerium*, and lake B, north of the *Læstrygon* estuary. Both these last objects were very difficult on the photographs.

(*h*) *Canals.*—Seventeen of these are more or less discernible on the images, corresponding, with one exception, to canals of Schiaparelli's charts. These are—

Æthiops.—Very faint and almost imperceptible traces of this canal.

Amenthes.—Broad and diffuse, fairly easy.

Antæus.—Apparently the edge of a faint duskiness S. of *Cerberus.*

Astaboras.—Visible near its estuary, very faint.

Athyr.—Very faint, broad and diffuse, running from *Casius* into *Syrtis Major* viâ *Triton* and *Mœris Laci.*

Casius.—A broad dark marking in N. hemisphere.

Cerberus.—Quite plain, dark and broad.

Chaos.—Edge of a shading around *Elysium.*

Cyclops.—Faint and diffuse, curving to E. of its estuary.

Eunostos.—Easy.

Hephæstus.—A dusky smudge, very faint and diffuse.

Hyblæus.—Faint, but distinct.

Læstrygon.—Traces near *Mare Cimmerium*; might be the E. edge of the indefinite shading N. of *Cerberus.*

Nilosyrtis.—Quite plain and dark, though less so than *Cerberus.* It curves admirably to N.W.

Pactolus.—A very easy streak, running almost parallel to *Eunostos.*

Styx.—The dark edge of *Elysium* to N.E.

Triton.—Visible only as an intensification of the N. edge of *Hesperia.*

All these canals are diffuse.

(*i*) *Duskiness and white spots of N. hemisphere.*—The whole of the regions N. of *Elysium*, *Nuba*, and *Nilosyrtis* is slightly duskier than the equatorial regions.§ *Elysium* appears whiter than any

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* E. and W. are used here in their areographic sense.

† This lake has been seen thus by Mr. R. D. Givin of Sydney (N.S.W.) at the last opposition.

‡ Discovered apparently by Major Molesworth in 1896, *Memoirs B.A.A.*, vol. vi., part iii., p. 92, and chart.

§ On the objectivity of these shadings of the N. hemisphere, which are missing in some maps of Schiaparelli and Lowell, stress has been laid in *Memoirs B.A.A.*, vol. xi., part iii., p. 91. It would appear that the glare

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country of the torrid zone, while two dull white spots of unequal size protrude beyond the N. limb, and are divided by a narrow dark channel.

(*k*) *Evidence of change in the form and intensity of the dusky areas.*—Schiaparelli's long series of observations have established the modifications in tint of the Martian *Maria*. In 1888, for instance, he found *Mare Acidalium*, which is, during the spring of the N. hemisphere, by far the darkest area on the planet, greatly discoloured,* and this discovery of seasonal change has been fully corroborated by the joint results of the Mars Section of the British Astronomical Association as the *Mare*, which was black in 1896–1897, appeared paler at every succeeding apparition, so that in 1907 it was by no means darker than the southern seas, according to the Australian observers. But if the alterations in tint of the dusky spots are unquestionable, the changes in their outline do not seem to have been hitherto more than probable. I think, however, that the valuable photographs of Professor Lowell now furnish serious evidence, and even positive proof, of such modifications. Thus while, from 1877 to 1888, Schiaparelli, who was seeing much more delicate detail than is shown on the photographs, could never detect any condensation on the junction of *Cerberus* and *Cyclops* (fig. 3), the photographs of 1907 show here a huge lake, *Pambotis Lacus*, as easy to see as *Trivium Charontis* (fig. 4). The change is absolutely unquestionable, since Schiaparelli's exhaustive scrutiny could by no means have missed a spot visible at a glance on photographic discs of Mars measuring 4 millimetres in diameter. The alterations in the E. border of *Syrtis Major* tend to the same conclusion; for while that great dusky area had always the form of a regular V to Schiaparelli (fig. 5), the photographs show it

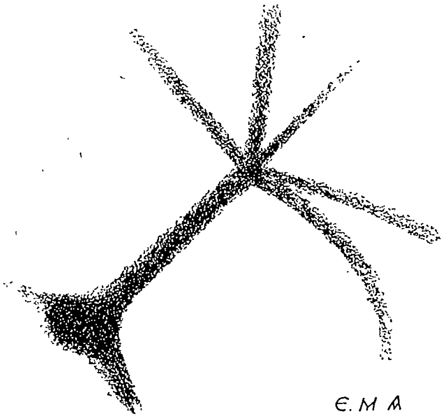

Fig. 3.—Invisibility of *Pambotis Lacus* from 1877 to 1888 (Schiaparelli).

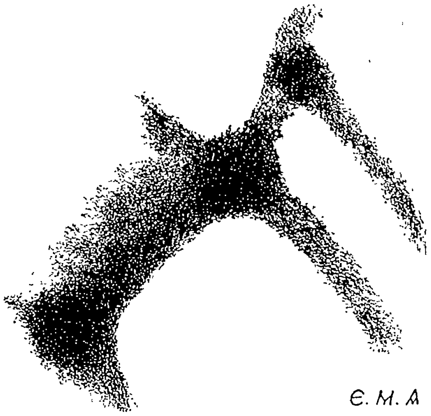

Fig. 4.—Appearance of *Pambotis Lacus* in 1907 (Prof. Lowell's photographs).

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of the Martian image in a large aperture is inimical to the visibility of these faint duskinesses. The discovery of Saturn's dark spots by Mr. Stanley Williams with a 6½-inch reflector and their invisibility to Prof. Barnard with the 36-inch Lick telescope may be accounted for in a similar manner.

* *Memoria sesta*, p. 38.

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distinctly to bulge to N.E., a modification which is also beyond the limits of observational errors. And thus the reality of change in the appearance of the grey markings is established on a strong basis.

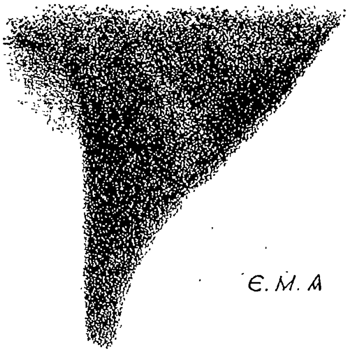


Fig. 5.—*Syrtis Major*, as it was generally seen from 1877 to 1888 (Schiaparelli).

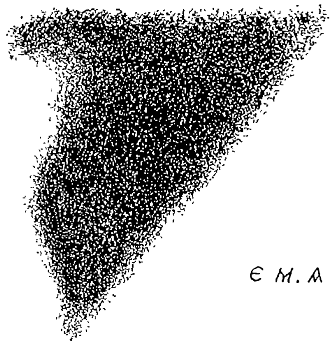


Fig. 6.—*Syrtis Major*, after the Lowell photographs of 1907.

Professor Lowell's photographs have given a great impetus to areography by enabling us to differentiate between objective and subjective appearance much more soundly than heretofore; and I should be glad to submit to a similar analysis any further prints I may have the good fortune to receive.

1908 *September* 23.

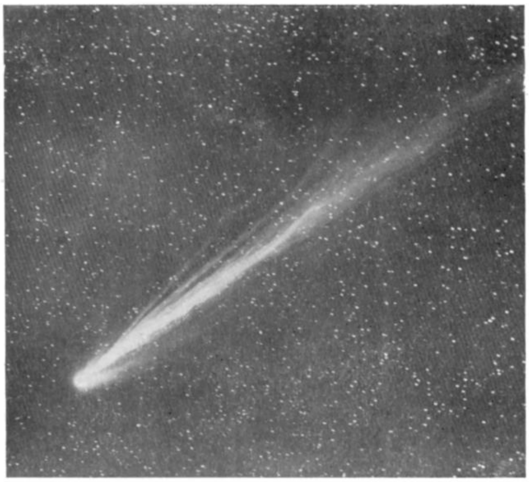
Photographs of Comet c 1908 (*Morehouse*).

By E. E. Barnard. (Plate 5.)

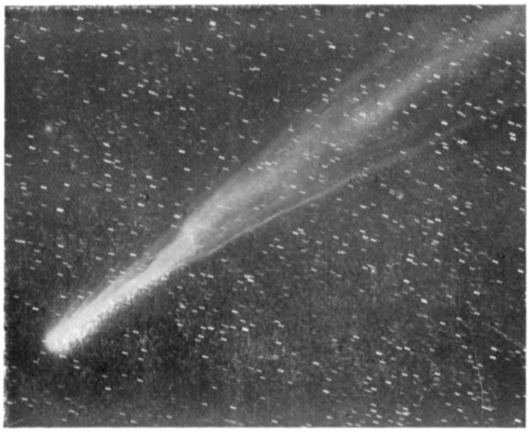
The following lantern slides which I have made are a continuation of those presented at the November meeting of the Society. They are from the most interesting of the negatives that I have made of the comet with the 10-inch Bruce doublet by Brashear.

List of Lantern Slides (*continued from p.* 53).

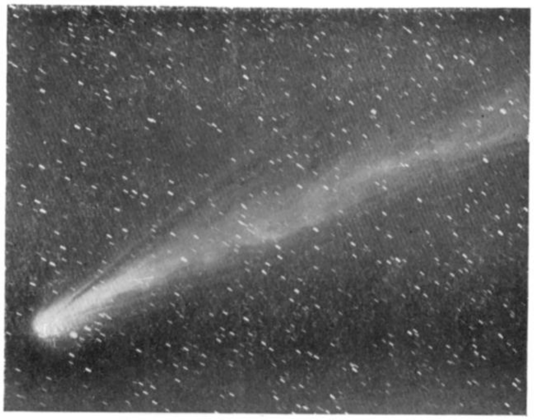
No.		d	h	m	
15	1908 Oct.	16	9	32	Centr. St. Time $6^h\ 0^m$ slow of G.M.T.
16		29	8	20	
17	Nov.	14	6	47	
18		15	6	6	
19		16	7	10	
20		17	7	37	
21		18	7	25	
22		19	6	9	



1908 Nov. 15 d. 6 h. 6 m. C.S.T.



1908 Nov. 16 d. 7 h. 10 m. C.S.T.



1908 Nov. 17 d. 7 h. 37 m. C.S.T.

COMET c 1908 MOREHOUSE.—E. E. BARNARD.